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Abstract

APPLICATION OF GEOLOGIC CONCEPTS TO FUTURE URANIUM EXPLORATION

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Most of the present important uranium mining areas in the U.S.A. apparently have reached or passed maturity. Rapidly rising requirements for nuclear power forecast for the 1970's will greatly exceed expected additions to reserves from operating mines and nearby areas and will have to be met primarily by production from new areas yet to be discovered. The development and use of geologic criteria of uranium-ore genesis and habitat will be the dominant factors in determining both regional favorability and specific exploration targets; it is expected that the major portion of newly discovered reserves of low-cost uranium will be in sandstone-type deposits. Geophysical and geochemical methods will play an important role in detailed exploration of new areas, but it is less likely that they will be the initial means of locating them.

Geologic concepts conforming to empirical data on the occurrence of uranium in sandstones and conglomerates are presented which, it is believed, form a promising basis for evaluating the uranium potential of unexplored regions in the U.S.A. and elsewhere in the world. These presuppose a relationship between the derivation of uranium and tectonic events (which are also associated with the formation of hypogene deposits of various metals) but do not necessarily require that the uranium be hypogene.

From studies of metallic ore deposits on the American continents, it has become apparent that belts or centers of strongest intensity and highest-temperature mineralization in any region generally coincide with linear tectonic units or occur at intersections of such units or at volcanic centers. Mineralization occurs in zonal arrangement and paragenetic sequence along decreasing intensity gradients radiating from these focal areas. Although uranium can occur in all zones, it is most abundant in the outermost, shallow, low-temperature zones where it is deposited from solutions with telethermal or ground-water characteristics. Fluids responsible for mineral zoning may deposit hypogene uranium or they may remove uranium from granite, tuff or other rocks during alteration and chemically modify them sufficiently to enable more effective supergene leaching. Supergene leaching of fresh rock may also be triggered by tectonic events, and deposition may occur in the same marginal areas favorable for hypogene mineralization.

Within low-temperature zones, uranium deposition in sandstones is controlled by features peculiar to the sedimentary-rock environment. The character and distribution of unoxidized ore bodies in permeable carbonaceous sandstones indicate the importance of reducing and oxidizing processes in ore formation. Ore bodies are directly related to interfaces formed by the incursion of oxidizing ground waters into reducing zones created by anaerobic bacterial decay of organic matter. Potentially productive ground can be delineated by locating these boundaries by means of their conspicuous mineralogical features.

Areas providing coincidence of low-temperature hypogene zones, migration channels for supergene solutions and favorable sedimentary environments occur generally along the common margins of orogenic uplifts and adjacent continental basins. An assessment shows the uranium possibilities of various regions in the U.S.A. and elsewhere in the world where such favorable loci are presumed to exist.